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State of Utah
DEPARTMENT OF NATURAL RESOURCES
BRIAN C. STEED
Executive Director
Division of Oil, Gas and Mining
JOHN R. BAZA
Division Director

January 22, 2020

Kirk Nicholes, Resident Agent
Alton Coal Development, LLC
463 North 100 West, Suite 1
Cedar City, Utah 84720

Subject: Appendix 9-1 Prime Farmland Soils, Alton Coal Development, LLC, Coal Hollow Mine, C/025/0005, Task #6047

Dear Mr. Nicholes:

The Division has reviewed your application. The Division has identified deficiencies that must be addressed before final approval can be granted. The deficiencies are listed as an attachment to this letter.

The deficiencies authors are identified so that your staff can communicate directly with that individual should questions arise. The plans as submitted are denied. Please resubmit the entire application by no later than February 21, 2020.

If you have any questions, please call me at (801) 538-5350.

Sincerely,

Steve Christensen
Coal Program Manager

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Technical Analysis and Findings

Utah Coal Regulatory Program

PID: C0250005
TaskID: 6047
Mine Name: COAL HOLLOW
Title: APP 9-1 PRIME FARMLAND SOILS

Summary

This amendment provides the results of prime farmland soil analysis from samples taken prior to disturbance in 2018, as described in Volume 9, Section 317.400.

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Special Categories

Prime Farmland Application Contents

Analysis:

The application does not meet the State of Utah R645 requirements for Prime Farmland: Soil Survey.

Although Appendix 9-1 provides the 2018 North Lease pre-disturbance prime farmland soil data required by a commitment in Volume 9, Section [R645-302]-317.400, the information is incomplete. Appendix 9-1 Procedures should explain how the nuclear gauge measurements were taken. The Appendix 9-1 Summary section should explain why the IML data is not accurate for bulk density. The Summary should also explain the utility of the nuclear gauge compaction measurement for redistribution of the prime farmland soils. Table 2 Summary of the nuclear gauge data should present only the nuclear gauge field data (dry density, %moisture content, % compaction and the conversion of dry density units to g/cm^3.

The following information is found within Appendix 9-1:

Figure 1 shows sample locations;

Appendix A provides the Intermountain Laboratory data;

Appendix B provides photographic documentation of each soil pit and the pedon sampled;

Appendix C provides photographs of the soil profile box made to archive each location;

Appendix D is the GEM Engineering field density test summary sheets, with a comparison to laboratory density analysis of the soil profile at each sample location.

This data was gathered to add to the previously collected baseline data for prime farmland soil chemistry and density as

required by R645-302-314.120 . The density of the redistributed prime farmland soils is important because of its effect on yields (R645-302.317.510). Root growth decreases linearly with increasing bulk density. Bulk density is defined as the weight of dry soil per unit of volume and is expressed in g/cm^3. Roots cannot penetrate silty clay with a bulk density of 1.58 g/cm^3 or greater. Roots cannot penetrate pure clay with a bulk density of 1.47 g/cm^3. Roots cannot penetrate sand with a bulk density of 1.75 g/cm^3 or greater (NRCS). To report bulk density, one must have a volume component.

Appendix 9-1 describes the procedure for collecting soil samples for laboratory analysis. In June 2018, soil pits were excavated to four feet deep on 2.2 acre centers. Soil samples were taken by horizon or in 12 inch increments, bagged and sent to Intermountain Laboratory (IML) in Wyoming for analysis of parameters described in Section R645-302-317.400. Soil pH was also monitored during salvage. Most of the soils sampled had a texture of silty clay loam or silty clay. Analytical data from IML provides an excellent record of the existing pH, EC, SAR , available water capacity and texture of the soil. The IML bulk density data is not accurate, because the volume of the original soil core was not recorded. The IML bulk density data were obtained by picking out a soil clod from the 1 gallon bag. The volume of the clod was obtained by coating it in paraffin (to preserve the pore space within) and measuring its displacement in water. (The methods and results were confirmed with K. Secor , Intermountain Laboratory, 1/14/20). IML reported bulk density values were between 2.69 tand 24.5 g/cm^3. Compare those reported bulk density figures to the average bulk density of rock, 2.65 g/cm^3. (NRCS)

Gathering and preserving soil aggregates for a bulk density analysis is a laboratory method which is unsuitable for monitoring redistributed prime farmland soil density in a timely manner. Therefore, the Permittee employed GEM Engineering to gather nuclear gauge data in an effort to develop a rapid analysis of compaction and a pre-disturbance data set. The Appendix 9-1 Procedures should explain how the nuclear gauge measurements were taken and the utility of the compaction measurement with regard to the redistribution of prime farmland soils.

The GEM Field Density Test Summary in Appendix 9-1, Appendix D, presents a lot of information, only some of which is pertinent to the density of the undisturbed prime farmland. For example, the columns of **laboratory data** relate the optimum moisture for maximum compaction and the corresponding density at maximum compaction in lbs/ft^3. [Since engineers are concerned with getting maximum compaction, the laboratory results are intended to be used when achieving maximum compaction is the goal. This situation is to be avoided on agricultural lands.] The Appendix 9-1, Table 2 Summary of the nuclear gauge data should omit the laboratory data which is not relevent to the discussion of agricultural yield. Table 2 should present only the nuclear gauge field data (dry density, %moisture content, % compaction and the conversion of dry density units to g/cm^3.

The Appendix D columns of **field data** provides readings of pre-disturbance % compaction and moisture content, which are converted into dry density (three right hand columns of the data sheet). The dry density measurements reported in lbs/ft3 can be converted to g/cm^3 by a factor of 0.016. (i.e. 1 lb/ft^3 x 0.00058 lb/in^3 x 27.6799 g/cm^3 = 0.016 g/cm^3).

For example: Prime 1, -6" sample has a dry density value of 76.7 lbs/ft^3 . It's dry density (at 18.3% moisture) equates to 1.23 g/cm^3. i.e. 76.7 lb/ft^3 x 0.016 = 1.23 g/cm^3. This is the particle density of the soil. The value accounts for pore space at a specified moisture content.

Citation:

NRCS publication Soil Bulk Density/Moisture/Aeration. Guides for Educators. Available online at https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_053260.pdf .

Deficiencies Details:

The application does not meet the State of Utah R645 requirements for Prime Farmland Soil Survey. The following deficiency must be addressed prior to final approval:

R645-302-314.120, Appendix 9-1 provides the 2018 North Lease pre-disturbance prime farmland soil data required by a commitment in Volume 9, Section [R645-302]-317.400, however, the information is incomplete. Appendix 9-1 Procedures should explain how the nuclear gauge measurements were taken. The Appendix 9-1 Summary section should explain why the IML data is not accurate for bulk density. The Summary should also explain the utility of the nuclear gauge compaction measurement for redistribution of the prime farmland soils. Table 2 Summary of the nuclear gauge data should present only the nuclear gauge field data (dry density, %moisture content, % compaction and the

conversion of dry density units to g/cm^3.

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Prime Farmland Soil Replacement

Analysis:

The application does not meet the State of Utah R645 requirements for Prime Farmland: Performance Standards, Soil Reconstruction.

Reclamation plans to prevent compaction of prime farmlands are described in Volume 9, Sections [R645-302]-317.510 and 317.530. Nuclear gauge percent compaction results are presented in Appendix 9-1 to document the prime farmland baseline density. The method of demonstrating that the density of reconstructed prime farmland soil will not limit yield using this procedure has not been explained in Appendix 9-1 or Chapter 9.

The narrative should explain how the Table 2 data will be used in final reclamation analysis. Increments of the replaced subsoil and topsoil might be measured by nuclear gauge and %compaction compared with the undisturbed prime farmland soil. The nuclear gauge method may be an accurate way to confirm that replaced soil layers approximate the original particle density or % compaction, however, it is uncertain whether the %moisture must be accounted for and what the final comparison figures will be. i.e. dry densisty adjusted for %moisture or %compaction.

A soil penetrometer gathers data on cmopaction and may be easier to use. The soil penetrometer measures soil resistance in lbs/in2 or psi. A root-rejecting resistance of 300 psi is commonly recognized (Sax and Bassuk). The Rutgers Experiment Station also recognizes 300 psi as root limiting resistance and recommends taking a minimum of 10 samples per acre. The Permittee may use either method of demonstrating that density of reconstructed prime farmland soil will not limit yield, but must explain the method to be used in Chapter 9.

Citations:

Miles S. Sax and Nina Bassuk, Cornell University in Remediating Compacted Soils Compromised by Urban Compaction. A webinar hosted by Utah State University Forestry Extension
https://www.youtube.com/watch?v=MQnl21l48yo

Rutgers New Jersey Experiment Station. 2018.Use of a Penetrometer to Assess Soil Compaction.
https://www.soildistrict.org/wp-content/uploads/2018/03/RCESoilCompactionSOP2018.pdf

Deficiencies Details:

The application does not meet the State of Utah R645 requirements for Prime Farmland Soil Reconstruction. The following deficiency must be addressed prior to final approval:

R645-302-317.510, The method of demonstrating that the density of reconstructed prime farmland soil will not limit agricultural yield using the nuclear gauge (or other) procedure must be explained in Appendix 9-1 or Chapter 9. The narrative should explain how the Table 2 data will be used in final reclamation analysis.

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